

Comparison of Carrington's Circumpolar Catalogue with the Greenwich-Groombridge System. By W. G. Thackeray.

(Communicated by the Astronomer Royal.)

The forthcoming Greenwich Catalogue for 1900 will consist of two parts : Part I., Fundamental and Zodiacal Stars ; Part II., Astrographic Reference Stars. This latter part consists of some 10,000 circumpolar stars within 26° of the pole. As the Carrington Catalogue affords the only data from which the proper motion of the majority of the stars within 9° of the pole can be determined, it is necessary to investigate its systematic errors, and for this purpose a comparison has been made with those stars which are common to it and the Groombridge-Greenwich system. There are ninety-four stars available, which have been grouped in degrees according to the Carrington Catalogue place.

The Carrington Catalogue contains 3735 stars, extending from 0° to 9° polar distance. The positions are based on instrumental errors derived from twenty special polars the places of which were finally determined by reference to double transits of *Polaris* and *Ursæ Minoris* (Introduction, pp. 13, 22-35). Four or more of these stars—two above pole and two below pole whenever possible—were taken for the determination of the meridian error and of the polar point (p. 15). The circle, which was made to turn on its collar and which was divided by Troughton & Simms's well known engine, was not provided with any means for the determination of errors of division. As the circle was not moved by Carrington during the period covered by his catalogue observations the division errors are the same throughout and necessarily remain uncorrected (p. 16). There were four fixed microscopes with which to read the circle, a vertical and horizontal pair, but after the first year only the horizontal pair were used (p. 7). The catalogue stars were observed and arranged in three sub-zones.

The first sub-zone from $45'$ to 4° of N.P.D.

„ second	„	„	4°	„	7°	„
„ third	„	„	7°	„	9°	„

The places of the stars in the first sub-zone depend on practically an equal number of observations above and below pole. The stars in the second sub-zone for 4° to 6° are mostly observed for the first three hours either one above or two below, or two above and one below. For 7° , with few exceptions, and for the third sub-zone, stars are observed entirely above pole.

The results of the comparison taken as corrections to Carrington's Catalogue place given in the following tables are :—

March 1906.

Circumpolar Catalogue etc.

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	0°. _s	1°. _s	2°. _s	3°. _s	4°. _s	5°. _s	6°. _s	7°. _s	8°. _s	9°. _s
R.A.	+0.7	+0.4	-0.3	-0.1	+0.2	-0.4	-0.3	-0.2	-0.4	0.0
N.P.D.	-0.3	+0.3	+0.5	+0.6	+0.9	+1.0	+1.1	+1.2	+1.4	+0.1
No. of stars	1	7	4	11	10	15	11	11	17	7

It has been decided to apply a systematic correction of $-0^s.3$ to the right ascension of stars of 5° to 9° N.P.D. The corrections to the north polar distances which are regular and systematic seem to point to the influence of uncorrected division errors, and this is confirmed from further comparing the observations above with those below pole, which can be easily done from the ledgers in the sub-zones where the observations below the pole are marked with an asterisk (*) and the difference from the adopted catalogue place given for each observation.

The following is the excess of N.P.D. above pole :—

0°.	1°.	2°.	3°.	4°.	5°.	6°.	7°.
-0.1	-0.3	-0.4	-1.0	-1.0	-1.3	-1.4	-1.6
12	122	178	302	104	95	121	6

The stars at 4° are made up of thirty-nine stars in the first sub-zone and sixty-five in the second sub-zone.

The following are the systematic corrections to be adopted for the north polar distances.

For the second sub-zone in which the observations below pole are not symmetrical and are most numerous at 0^h-3^h , in order to obviate systematic differences it will be first necessary to bring into line the catalogue place of all stars which have S.P. observations by applying a correction to all S.P. observations as follows :—

N.P.D.	Correction.
0	—
4	-1.0
5	-1.3
6, 7°	-1.4

Then, as the first sub-zone contains an equal number of observations above and below pole, and in the third sub-zone all the observations are above pole, the following are adopted as the corrections from the catalogue comparison :—

N.P.D.	Correction.	N.P.D.	Correction.
0, 1	+0.3	6	+1.1
2	+0.5	7	+1.2
3	+0.6	8	+1.2
4	+0.9	9	+1.2
5	+1.0		

Comparison between Carrington and Groombridge-Greenwich in R.A. for each 1° of N.P.D.

0°.	1°.	2°.	3°.	4°.	5°.	6°.	7°.	8°.	9°.
$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ s & s \end{smallmatrix}$
0.7*	0.2*	0.3	1.4	0.9	0.5	0.2	0.0	0.2	0.1
0.3*	0.6*	0.6	0.2	0.7	0.9	0.3	0.3	0.5	0.5
0.1*	1.0	0.1	0.3*	0.5	0.1	0.1	0.2	0.5	0.5
0.2*	0.0*	0.3*	0.6*	0.4	1.1	0.1	0.1	0.2	0.2
0.7	...	0.5*	0.0	0.8	1.2	1.4	0.2	0.2	0.2
0.6*	...	0.4	0.8	0.6	0.1	1.0	0.6	0.5	0.5
1.5	...	0.1	0.5	0.4	0.4	0.2	0.3	0.4	0.4
...	...	0.1*	0.6	0.3	1.1	0.0	0.3	...	...
...	...	0.7	0.4	0.4	0.1	0.5	0.6	...	...
...	...	0.1*	0.2	1.0	0.0	0.3	0.5	...	...
...	...	0.1*	...	0.8	0.5	0.1	0.8	...	...
...	...	...	...	0.6	...	...	0.9	...	...
...	...	...	...	0.1	...	...	1.2	...	...
...	...	...	...	0.4	...	...	0.6	...	...
...	...	...	...	0.0	...	...	0.0	...	...
...	...	...	...	...	...	...	0.2	...	...
...	...	...	...	...	...	...	0.2	...	...
Means	+0.4	-0.3	-0.1	+0.2	-0.4	-0.3	-0.2	-0.4	0.0

Comparison between Carrington and Groombridge-Greenwich in N.P.D. for each 1° of N.P.D.

0°.	1°.	2°.	3°.	4°.	5°.	6°.	7°.	8°.	9°.
$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$	$\begin{smallmatrix} + & - \\ " & " \end{smallmatrix}$
" 0.3*	" 1.2*	" 0.7 "	" 0.1 "	" 0.9 "	" 1.2 "	" 0.5 "	" 0.3 "	" 1.7 "	" 1.4 "
0.1*	0.4*	0.4	0.8	1.8	1.3	1.7	0.8	0.4	0.4
0.2*	0.7	1.1	0.8*	0.5	0.4	1.7	1.6	0.5	0.5
0.9*	0.3*	0.7*	0.7*	1.8	1.5	2.3	1.6	1.2	1.2
0.3	...	1.1*	0.3	0.9	1.1	1.0	0.4	0.9	0.9
0.3*	...	1.4	1.2	0.6	1.4	1.0	1.1	0.9	0.9
...	...	1.2	1.9	1.0	1.3	1.6	1.5	1.4	1.4
...	...	0.2*	1.1	1.1	1.0	0.6	0.7	...	...
...	...	0.2	0.4	0.6	1.3	2.8	1.2	...	...
...	...	0.5*	1.2	1.3	1.2	1.2	2.6	...	...
...	...	0.4*	...	0.9	0.8	0.5	1.5	...	...
...	...	...	...	0.9	...	...	2.0	...	...
...	...	...	...	1.0	...	...	1.5	...	...
...	...	...	...	1.5	...	...	1.7	...	...
...	...	...	...	0.3	...	...	2.0	...	...
...	...	...	...	...	...	...	1.4	...	...
...	...	...	...	...	...	...	0.4	...	...
Means	+0.3	+0.5	+0.6	+0.9	+1.0	+1.1	+1.2	+1.4	+1.0

Reference Numbers from Carrington's and Groombridge's Catalogues of the Comparison Stars for each 1° of N.P.D.

0°.	1°.	2°.	3°.	4°.	5°.	6°.	7°.	8°.	9°.
<div>Carr. Groomb. 1035* 1119</div>	<div>Carr. Groomb. 117* 144</div>	<div>Carr. Groomb. 140 175</div>	<div>Carr. Groomb. 145 195</div>	<div>Carr. Groomb. 52 67</div>	<div>Carr. Groomb. 451 595</div>	<div>Carr. Groomb. 1538 1633</div>	<div>Carr. Groomb. 593 774</div>	<div>Carr. Groomb. 76 100</div>	<div>Carr. Groomb. 346 506</div>
	181*	956*	236	131	1127	2080	1165	1021	429
	1834*	1830	491	575*	1516	2105	1222	1045	675
	1972*	2316*	842*	770*	1746	2222	1807	1301	2348
	2048	...	1793*	782	1790	2261	2360	1381	2276
	3058*	...	2122	1205	1818	2404	2550	1558	3140
	3138	...	2258	2001	1836	2648	3323	1580	3276
			2755*	3441	1843	2729	3387	1698	1778
			2771	3444	1847	2820	3389	1707	1782
			3273*	3693	1882	2822	3502	1774	1842
			3621*	...	1913	3525	3681	1784	1843
					1914	...	...	1868	1909
					2271	...	...	1889	1927
					3091	...	...	1968	1977
					3123	...	...	2088	2071
								3133	3261
								3189	3370

An asterisk (*) denotes that the star was one of Carrington's special polars.

The Total Solar Eclipse of 1908 January 3.

By A. M. W. Downing, D.Sc., F.R.S.

There are two Pacific islands favourably placed for the observation of this eclipse, viz. Hull Island, one of the Phoenix group, and Flint Island, one of the Line group. The astronomical details of the eclipse for these two islands are given below, the calculations having been made from the data of the *Nautical Almanac*. As the errors of the Moon's tabular places now amount to sensible, and apparently increasing, quantities, observers are warned that the calculated times of the various phases of the eclipse may differ considerably from the observed times, the calculated times being (with the present values of the errors) too late. In order to obviate, as much as possible, inconvenience arising from this cause, I have added in each case the intervals in time from the instant when the cusps subtend an angle of certain specified value at the Sun's centre to the commencement of totality.

The plans of the islands here reproduced are taken from the official charts published by the Hydrographic Office. The geographical details are abridged from the *Admiralty Sailing Directions, Pacific Islands*, vols. ii. and iii., 3rd ed., 1900.

The offices of Levers' Pacific Plantations Company, mentioned below, are situated at Port Sunlight, Cheshire. Intending observers of the eclipse should communicate with the Company at this address.

My thanks are due to Capt. A. M. Field, R.N., F.R.S., for his kindness in referring me to the available sources of information regarding these islands.

HULL ISLAND. Long. 172° 13' W. Lat. 4° 30' S.

Mean Solar Time.

		Greenwich.				Local.				Angle from	
		d	h	m	s	d	h	m	s	North Point.	Vertex.
First Contact.	...	Jan. 3	7	18	33	Jan. 2	19	49	41	281°	5°
Total Eclipse	...	{ 3 8 30 36				{ 2 21 1 44				88	162
		{ 3 8 33 27				{ 2 21 4 35				294	8
Last Contact	...	3	9	58	12	2	22	29	20	100	155

Duration of totality, 2m. 51s.

Sun's altitude at totality, 43°.

Angle of Cusps.	Time before Commencement of Totality.
°	s
90	34
60	13
45	7
30	3
15	$\frac{3}{4}$